UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA, ex. rel. W.A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA and OKLAHOMA SECRETARY OF THE ENVIRONMENT, J. D. Strong, in his the capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA,

Plaintiffs,

v.

TYSON FOODS, INC., TYSON POULTRY, INC., TYSON CHICKEN, INC., COBB-VANTRESS, INC., AVIAGEN, INC., CAL-MAINE FOODS, INC., CAL-MAINE FARMS, INC., CARGILL, INC., CARGILL TURKEY PRODUCTION, LLC, GEORGE'S, INC., GEORGE'S FARMS, INC., PETERSON FARMS, INC., SIMMONS FOODS, INC., and WILLOW BROOK FOODS, INC.,

Defendants.

Case No. 05-CV-329-GKF-SAJ

EXPERT REPORT OF

Timothy J. Sullivan, Ph.D.
President

E&S
Environmental
Chemistry, Inc.

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under all flow conditions, were above some water quality standards, but nevertheless were about half as high as the median values reported by USGS for the 250 nationally representative riverine monitoring stations.

Based on results of analyses summarized above, compared with streams and reservoirs sampled in many studies throughout Oklahoma, the region of the IRW, and the United States as a whole, in a number of large surveys, neither the concentrations of TP nor fecal coliform bacteria in the IRW are unusual.

3. Water quality data in the IRW reflect a variety of sources associated with a mix of land uses.

The land area of the Illinois River watershed is a complex patchwork of urban, rural residential, agricultural, and forest land uses (Figure 3-1), with a variety of potential P and fecal indicator bacteria sources to stream water. Land application of poultry litter is only one among many potential sources. The most important sources of P to stream water are probably waste water treatment plant effluent, livestock, septic systems, erosion, and runoff from urban and other developed areas. The most important sources of fecal indicator bacteria are probably livestock, septic systems, urban runoff, accidental sewage discharge and other sewage bypasses, river recreationists, and wildlife. All of these sources contribute P and/or fecal indicator bacteria to stream water, dependent upon location, rainfall, flow conditions, human and animal populations, and variations in land use. Most of these sources were ignored or unreasonably dismissed as unimportant by the Plaintiffs' consultants in this case.

Because the land uses within the watershed are so patchy (see Figure 3-1) and because so much of the urban land use (a major source area of both P and fecal indicator bacteria to streams) is located in the headwater regions of the watershed, it may be impossible to discriminate precisely among the various nonpoint P and bacteria sources based on observed geographic patterns in P or bacterial concentration. Certainly the Plaintiffs' consultants did not design and implement a sampling program that discriminated among the various potentially important sources of NPS pollutants.

Headwaters are important in this assessment because stream flows in headwater areas are lower than further down the stream system, and therefore inputs of P and bacteria have larger influence on concentrations in stream water in the smaller headwater streams. Furthermore, contamination of streams with waste water treatment plant effluent and urban runoff in the headwater areas makes it difficult to evaluate the importance of multiple potential nonpoint sources of P and/or fecal indicator bacteria in agricultural and rural residential lands further downstream. Thus, streams in this watershed have concentrations of P and fecal indicator bacteria above water quality standards in the upper reaches of many of these stream systems, well above the mainstem Illinois River. The relative importance of each source is not known. These potential sources of P and bacteria cannot be ignored in any serious attempt to evaluate the possible causes of concentrations above standards at some locations in the IRW. There is no justification for singling out the poultry industry as the cause of P or fecal indicator bacteria above water quality standards in this watershed, especially given the large populations of people (on both sewered and septic waste water treatment) and cattle in the IRW. In addition, because of differences in the timing of improved land and facilities management, WWTP construction projects, and continued growth in the IRW, spatial patterns may be further obscured.

contributing P and fecal indicator bacteria to streams in the IRW that was largely ignored by Plaintiffs' consultants.

It is largely because cattle can represent a major NPS pollutant transport mechanism in pasture settings that agricultural best management practices (BMPs) commonly entail construction of fences (with associated off-stream watering systems) to keep cattle out of riparian zones and streams. Intended benefits of riparian fencing include reduced contamination of stream water with livestock feces and its associated nutrient and bacteria content, reduced trampling of riparian vegetation, and reduced stream bank and riparian erosion. Riparian fencing resource protection actions occur nationwide, in many cases funded by the federal government.

It is well-recognized that cattle pose an important source of NPS pollution to streams. In fact, Total Maximum Daily Load (TMDL) analyses in watersheds throughout much of Oklahoma typically conclude that cattle constitute the principal source of fecal indicator bacteria to streams (See discussion of this issue in Section III.6 of this report). Nevertheless, Plaintiffs' consultants largely ignored or dismissed the importance of cattle in the IRW, despite the large numbers of cattle present and the wide prevalence of their access to streams within the watershed.

Plaintiffs' consultants also failed to fully address the fact that feces from an estimated 170,000 swine that live in the IRW are commonly land applied. Waste water treatment biosolids have also been land applied (Jarman 2008). Plaintiffs' consultants did not appropriately address these potential sources of contaminants to stream water, but instead focus on poultry litter, nearly to the exclusion of other known and suspected sources of P and fecal indicator bacteria.

Change in Populations Over Time

The human population in the IRW has been increasing dramatically for the past several decades. Between 1990 and 2007, it increased by about 77% (Table 4-2). In fact, northwest Arkansas has been one of the fastest growing metropolitan areas in the United States in recent years. The total human population in the watershed has increased from about 168,000 people in 1990 to about 297,000 people in 2007 (Table 4-2).The estimated total human population in the IRW increased by over 40% just within the decade of the 1990s. Much of this increase has occurred in the headwater areas of the IRW in the northeastern portions of the watershed. Changes over just a seven year period of time are mapped in Figure 4-1. Human population increases have been especially pronounced in the upper (easternmost) part of the watershed.

Along with the large increase in human population has been a large amount of construction: of housing, shopping centers, and other human infrastructure. Construction activities and urban development are especially widespread throughout the headwater portion of the watershed. For example, Grip (2008) mapped, from examination of aerial photographs and existing maps, new land development in a study area between Rogers and Fayetteville, within the IRW. The study area comprised 152 square miles. Mr. Grip obtained aerial photographs that covered the study area, corresponding to four time periods: 1976-1982, 1994-1995, 2001, and 2006. Developed areas that involved residential and commercial development were identified and mapped, excluding any development that was focused on golf courses, parkland, forestry, crops or pasture. During the initial time period examined (1976-1982), 12.6% of the study area was classified as developed. By 1994-1995, this increased to 22.4%; by 2001, it increased to 29.4%. The cumulative development by 2006 had increased to 39.3%, more than three times the amount of developed land in the earliest period examined (approximately 24 to 30 years previously).

With construction and urban development, there is a substantial increase in the amount of impervious land surface (pavement, roofs, parking lots, compacted soils, etc). Runoff during rainstorms from these impervious areas is largely not directed down through soils (which could remove bacteria from the drainage water), but rather flows overland and through storm drains, providing direct conduits for bacterial and nutrient transport from the ground surface to stream water. Thus, eroded sediment and also bacteria and P deposited on the ground surface by pets, hobby farm livestock, or wild mammals and birds can be efficiently transported from such areas to streams. For this reason, urban areas and developed areas commonly constitute important sources of NPS pollutants to streams. Plaintiffs' consultants have ignored the rapid increase in the human population within the watershed, along with the concomitant large increase in such potential sources of stream pollution.

5. *Effluent and drainage water from urban areas in general, and municipal waste water treatment plants in particular, are major sources of P to surface waters in the IRW.*

Urbanization is well-known as a major source of NPS pollution in the United States (Dillon and Kirchner 1975, Novotny 1995). Nevertheless, it was not fully considered by Plaintiffs' consultants in this case. Other than providing a limited and incomplete evaluation of waste water treatment effluent sources to streams and deleting watersheds having urban land use from some analyses, aspects of urban contribution of NPS pollution were generally not investigated by Plaintiffs' consultants.

My analyses show that spatial patterns in measured total P concentrations in stream waters of the IRW indicate an association with urban land use, and especially with the location of WWTP effluent discharge. Analyses conducted and reported by Defendants' expert Dr. Connolly (2008) further support this conclusion. As described below, highest values of stream total P concentration tend to be located downstream of urban land use and especially downstream of WWTP effluent sources to the streams. Plaintiffs' own data show that the sites that exhibit the highest concentration of total P, expressed as the geomean of five or more samples at a given location, are immediately downstream of the locations of WWTPs, sewage lagoons and/or urban areas.

Plaintiffs' consultants ignored or failed to recognize that stream water P concentrations in the IRW tend to be highest immediately downstream of urban pollution sources. Their analyses were directed towards portions of the watershed assumed to receive land application of poultry litter, and they failed to fully consider the presence of other potential sources of the same constituents that they claimed were contributed to streams from poultry litter application.

As an example, Plaintiffs' consultants collected paired stream samples above and below three waste water treatment plant effluent discharge locations. The resulting total P data are depicted in Figure 5-1, showing that the concentrations of total P in the streams were generally below the 0.037 mg/L standard at the locations above the WWTPs, but substantially higher immediately downstream from the WWTPs. Plaintiffs' consultants did not report such observations in their various reports for this case.

Similarly, an analysis of data collected by Plaintiffs' consultants at variable distances downstream from several WWTP locations (shown in Figure 5-2) illustrate that concentrations of total P in stream water tend to be highest immediately downstream of the location of the WWTP